

What Is Claimed Is:

1. A process for producing an alkali metal comprising electrolyzing an alkali metal halide in the presence of a co-electrolyte which is (1) a nitrogen-containing compound and optionally one or more Group IB halides, Group IIIA halides, Group VIII halides; (2) a Group IIIA halide, a Group VB halide, or combinations of a Group IIIA halide and a Group VB halide; or (3) water.
- 10 2. A process according to claim 1 wherein said process is carried out at a temperature below 300°C.
- 15 3. A process according to claim 1, or 2 wherein said nitrogen compound is one or more compound selected from the group consisting of imidazolium salts, N-alkylpyridinium salts, tetraalkylammonium salts, and tetraalkylphosphonium salts.
- 20 4. A process according to claim 1, 2, or 3 wherein said nitrogen compound is one or more compound selected from the group consisting of 1-ethyl-3-methyl-1H-imidazolium, 1-propyl-3-methyl-1H-imidazolium, 1-butyl-2,3-dimethyl-1H-imidazolium, 1-butyl-2,3,4,5-tetramethylimidazolium, 1,2,3,4,5-pentamethylimidazolium, 1-methylpyridinium, a derivative of pyridine having alkyl groups in non-nitrogen positions on the ring, tetraalkylammonium, tetramethylphosphonium; said Group IB halide is copper halide, silver halide, or gold halide; said Group IIIA halide is aluminum halide, boron halide, gallium halide, indium halide, or thallium halide; and said Group VIII halide is iron halide, cobalt halide, or nickel halide.
- 25 5. A process according to claim 4 wherein said imidazolium halide is 1-ethyl-3-methyl-1H-imidazolium chloride and said Group IIIA halide is aluminum chloride.

6. A process according to claim 1, 2, 3, or 5 wherein said co-electrolyte comprises aluminum chloride and 1-ethyl-3-methyl-1H- imidazolium chloride and said process is carried out in an electrolysis cell containing an ion exchange

5 membrane.

7. A process according to claim 1 or 2 wherein said co-electrolyte comprises aluminum chloride and a fully alkylated imidazolium chloride and said process is carried out in an electrolysis cell containing an ion exchange membrane or a

10 diaphragm.

8. A process according to claim 1 or 2 wherein said co-electrolyte comprises aluminum chloride and tantalum chloride and said process is carried out in an electrolysis cell containing an ion exchange membrane.

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9. A process according to claim 1 or 2 wherein said co-electrolyte is water.

10. A process according to claim 9 wherein said process is carried out in an electrolysis cell whose cathode consists of a liquid, low melting alloy of two or more 20 metals selected from the group consisting of Bi, Pb, Sn, Sb, In, Ga, Tl, and Cd to produce an alkali metal.

11. A process according to claim 10 and wherein the alkali metal is separated from said alloy by distillation whereby a denuded liquid cathode alloy is produced 25 and recycled to the said cell.

12. An electrolysis process comprising carrying out said process using a cathode that comprises (1) a liquid alkali metal; (2) an alloy of two or more metals selected from the group consisting of bismuth, lead, tin, antimony, indium, gallium, thallium, 30 and cadmium; or (3) an electrically conductive liquid solvated alkali metal.

13. A process according to claim 12 wherein said cathode comprises a liquid sodium.

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14. A process according to claim 12 wherein said cathode comprises an alloy of two or more metals selected from the group consisting of bismuth, lead, tin, antimony, indium, gallium, thallium, and cadmium.

10 15. A process according to claim 12 wherein said cathode comprises an electrically conductive liquid solvated sodium and an organic solvent.

15 16. A process according to claim 15 wherein said alkali metal is separated from said organic solvent by distillation whereby a denuded liquid cathode alloy is produced and recycles to said electrolysis cell.

17. A process according to claim 1, 2, 3, 5, 10, 11, 12, 13, 14, 15, or 16 wherein said alkali metal is sodium, potassium, or lithium.

20 18. A process according to claim 17 wherein said alkali metal is sodium.

19. A process according to any of claims 17 wherein said has an impurity less than 400 mg per kg of said sodium.

25 20. An electrolyte composition comprising an alkali metal halide and (1) a nitrogen-containing compound and optionally one or more Group IB halides, Group IIIA halides, Group VIII halides; or (2) a Group IIIA halide, a Group VB halide, or combinations of a Group IIIA halide and a Group VB halide.